Do the Blind Have a
Sense of Obstacles?

WLADIMIR DOLANSKI

AMERICAN FOUNDATION
FOR THE BLIND INC.

Dolanski, Wladimir.

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by Wladimir Dolanski.

introduction;

The hallowed tradition that man has only five senses is now consigned to oblivion, for science has shown that even in the skin we have numerous senses, such as temperature, pressure and pain. The existence of an obstacle sense is then theoretically possible, and we have evidence in certain exceptional cases of the power to perceive obstacles not only among the blind- who are most deeply interested in the subject - but also among the seeing. We are not now attempting to discover a special sense organ which would directly endow the blind with the power of receiving sensations to warn them of objects in front of them; yet we speak of such a sense, as we do of a sense of time, of distance, or of orietntation.

The present article, a resume in french of a report soon to appear in polish, is an attempt to clarify the whole subject, by agathering together in chronological order all that has been written thus far, quoting the theories offered to explain the phenomenon, and the observations made during a period of years by the author himself, as well as the specific results of his experimentation.

Diderot was the first to draw the attention of the scientific world to the ability of the blind to perceive obstacles, in his famous publication "Letters of the Blind". When in the last quarter of the eighteenth century Valentin Hauy undertook in Paris the systematic instruction of the blind, and all the European states in succession imitated him, numerous groups of blind people were ~~formed~~ formed and it was possible to test the truth of DiderOt's words.

It was observed particularly that the blind were able to stop before an obstacle at the very moment when a collision seemed inevitable; that, thanks to this ability to perceive objects placed in their way, they were able to avoid them and enjoy a certain freedom of movement themselves.

This phenomenon aroused considerable interest during the nineteenth century, and recently numerous writers, some of them blind themselves, have been trying to throw light upon the subject. All blind people agree in saying that they sense obstacles by means of the face, particularly by the forehead, temples, and cheeks. The question would seem to be clear and to present no special difficulties due to this exact localization of the sensation; but experimenters find a mask of contradictory and inexplicable assertions. This is the fault of writers who have rashly published the testimony of blind people without a sufficient examination of this phenomenon which involves various mental factors. And some of the blind exaggerate the facts in order to acquire a halo of superiority; others - in good faith - give the facts a false interpretation.

Historical:

There is no special monograph on the subject, in which a study is made in all its aspects, relying on objective observations supported by experiments. All that has been written on the subject appears in unconnected notes, minor articles, or short compilations attempting to explain the phenomenon.

Zeune (1808) believes that the blind perceive the nearness of objects by the use of the head. Since the blind walk with the head pressed forward, the forhead and cheeks serve as ~~tentic1es~~ anntennae, like those used by the lower animals.

Knie (1821) thinks the perception of obstacles is mediated by atmospheric pressure.

Luzardi ( ) observes that the blind are obliged to concentrate ~~their~~ attention and that this tends to increase their memory. The lack of one sense does not seem to him necessarily to augment the efficiency of the other senses. The blind have no special advantage over the seeing and their delicate sense of touch is due only to its constant use as a substitute for sight. Blindness stimulates the other senses to a more marked activity and develops in them to some extent a greater skill, which is thus seen to be acquired and not innate . This sharpening of the senses is based on mental factors and varies greatly with individuals.

Sergel (1867) defines the obstacle sense as the ability to perceive objects at a distance. With a certain degree of attention objects may be well perceived by the face, without the assistance of sound-, light-, heat - waves. He believes that the sense of distance is most ~~scarce~~ acute around the eye and ear, weaker on the temples and forehead, still weaker on the cheeks, and weakest on the lips. He states that a hanging cloth stimulates in the same way as a tree, a stone or iron object, when the surface, exposed to the blind subject, is equal in distance, postition, and area. Approach to the object produces a

peculiar and vague sensation. The writer claims to be able to perceive ordinary trees at a distance of eight feet, in the street, and to perceive a hand at a distance of three inches. It is impossible for him to judge the exact dimensions of an object, nor can he describe the shape of objects, - only their presence. The size of a solid body can be judged only approximately. When a person in a state of inattention approaches an object rapidly, the sense of obstacle does not develop; when he approaches slowly, it becomes quite acute. In a strong light the sense is weak and dull, especially when the light falls directly upon the face of a blind person. The sound, which aids in the perception of objects, arising in advance of thesense of distance, tends to enhance the latter. Also, when the blind wish to find their way about they use slight sounds to guide them. A loud sound is of no more help than a soft one; in fact a very loud, clear noise is confusing. And illusions frequently occur in the perception of obstacles.

Sergel is correct in claiming that the blind make use of the sense of obstacles intuitively, and that it is the seeing who, in observing them, draw their attention to this faculty. Sergel defines the sense of obstacles as a special means of perceiving certain sensations and of distinguishing them from others such as , the auditory sensations, which help the blind so much in orientation.

Levy (1872) asserts that the sense of obstacles is quite unrelated to the other senses. He looks upon it as a sixth sense, and calls it "percepcio facialis". Somewhat incredible things have been written about Levy. He could distinguish windows from doors; he had more

difficulty in recognizing a window made of large panes, than one divided into little squares; when the lower part of a house was built of bricks and the upper part of wood, he could easily distinguish the line of demarcation; he even perceived the inequalities of a wall - the humps and hollows.

Scherer (1874) agrees with Sergel, although he claims that the sense of distance is not stable, but changing according the behavior of the object, its distance, and the manner of approaching it. He distinguishes living from inert objects, and find that the effects of objects upon the individual may be of three kinds; 1. ~~the~~ attractive if the individual is at a certain distance; 2. repulsive if the individual comes too near the object; 3. neutral at the moment he encounters the object. Water has the same effect as a metal; objects made of two materials have twice as much effect. Scherer believes that the sense of obstacles extends over the whole surface of the body, although the clothing some what neutralizes it. The ears, eyes, and cheek are the most sensitive parts.

Dufour (1895) reports that Valladier, a blind man, perceived the presence of a reflector at a distance of one to two meters, a tree trunk at three metres, a house a t fifteen meters. To be perceived at all, an object must be at least knee-high, while all objects which are as high as the shoulders are easily perceived. From his experiments he concludes that what the blind designate as the density or resistance of the air is only an auditory sensation.

Javal (1902) thinks that man possesses a sixth sense, analgous to touch but not identical with it. This sense might be stimulated by the same vibrations that affect the retina and other organs. The varying sensations which the blind receive from the world about them are attributed by him to this sixth sense, whose sensitiveness is even greater than that of touch. The difference is that in touch we receive sensations only through direct contact with the object while the sense of obstacles is aroused by ether-waves. Javal raises the question whether it would be worthwhile to find out if the ultra-violet rays are involved in the sense of obstacles.

Happtvogel (1906) believes that the tympanic membrane serves as a receptive disc for the sense of obstacles and that it is stimulated by some substance in the atmosphere like ether or od.

Wofflin (1908) has made the following ~~expermine~~ experiments. He had his blind subjects approach a board 1 metre square and 3 centim. thick which could be made smaller at will. These experiments showed that there are different degrees in the ability to perceive objects and that this ability may be reduced to zero. Among his forty subjects, nine showed the ability in a high degree. The ears of these subjects were stopped up, and they were asked to walk in the direction of the board, which they perceived only when they were very close to it. Half of these subjects could determine the size of the board with surprising accuracy. When the area of the board was reduced by half, the ability to perceive it was also reduced by nearly a half. Wofflin also experimented with cloth masks of different shapes. He uncovered the forehead, cheeks; then he covered the whole face, and the

whole head; finally he put a double mask on the subject. In the first two experiments the difference in the sensations was slight, in the last experiment there were no sensations at all. Wofflin is convinced that the sense of obstacles is not ~~dipeneant~~ dependent upon ~~such~~ touch sensations ~~upon~~ in the face, upon hearing, atmospheric pressure, or changes in temperature. He concludes that the sense of obstacles has some entirely different source, which he finds in the nerve supply of the face, and especially the nerve called " nervus trigeminus." His conclusions cannot be accepted without further experimentation.

Romagnoli (1908) in his book " Introduzione alla Educazione dei Ciechi", has several passages on the sense of obstacles. He is of the opinion that it is difficult to separate it from hearing, the perception of temperature, and of ~~aeir~~ air currents.

Lang (1918), blinded late in life, calls the sense of objects a gift which some possess, - a special talent. Where it is found it can be developed and perfected; when it lacking or very weak, it is useless to look for it.

Gerhardt (1920) considers the sense of obstacles a synthesis of several sensations, adding that there may be individuals of delicate organisation who go beyond the sensations given by the five senses. For instance, he ~~sight~~ cites the case of a student blind from birth, upon whom metals have a special influence. So the author concludes that this blind man is sensitive to magnetic forces.

It is not surpfising that such propositions, many of which are quite unfounded, have made the task of investigators more difficult. We are confused by guesses; we seek to find in the blind a unique sense which is variously called a distance sense or feeling; it is named in German Fernsinn, Ferngefuhl, Fernempfindugg, Fernsensibilitat, and the like; in French, tact a distance, vision a courte distance, and finally - ~~duch~~ the most characteristic of this mode of thought, - le sens X.

Theories about the sense of obstacles:

The researches of the last twenty-five years have a greater significance, for recent writers, trying to break the vicious circle of hypotheses, make an effort to establish the causes for the phenomenon.

Thus there have appeared; 1. the auditory theory of Truschel; 2. Kunz's theory of pressure; 3. the thermic theory of Krogius. As a matter of fact these writers bring us nothing new, for their conclusions had been presented earlier by their predecessors, although in somewhat chaotic form. But they have approached the subject more scientifically, and have furnished argumen s which, up to the present, have, to many, seemed decisive.

1. The Auditory Theory of Truschel;

Truschel (1907) determined by analysis the roles of persistent auditory sensation, eliminating from the question; the tactual and thermic stimulation of the skin. His work is particularly important because he takes into account the dimensions, form and position of objects involved, and the conditions under which the sound waves

which they reflect may reach the ear of the subject. The analysis of the sound of footsteps gave Truschel certain positive results. He has shown that a modification in the sound of footsteps, caused by the reflection of sound waves, is important not only in the perception of objects, but also in determining their approximate position and distance.

Truschel makes it clear that when an individual moves along on a line parallel to an obstacle, the intensity of the sound reflected increases until he reaches the obstacle, and remains at a constant intensity during the time required for passing it. When the subject approaches on a line crossing that of the object, the intensity of the sound of the footsteps increases gradually. In the perception of an object, Truschel does not attribute any influence to the timbre of the sound, which varies with the material, dimensions and form of the objects. If there are no odors or sounds in the neighborhood, and both the object and the individual are motionless, so no current of air is produced, he consides that the perception of the object is due to the reflection of sound waves. When such waves are too weak to arouse auditory sensations,[2] Truschel thinks that they are received not by the organs of hearing, but by the static organs, - "tonus- labyrinth".

Truschel disciminates two ways of perceiving obstacles; 1. the first consists in determining the presence of the obstacle by modification of the sounds which it causes; 2. the second consists in determining the presence of an object in absolute silence, that is with no sounds to help one. In the first case the modification of sound is the cause of the perception of obstacles, in the second case "die Raumqualitat[2]

- as Truschel calls it , in other words, the spacial quality - is the cause. We shall use the words "spacial property" for any space, open or closed, possessing those qualities which facilitate the orientation of the blind. Up to the present time we have been satisfied to explain the perception of distance by auditory sensations; Truschel is the first to take into consideration the spacial properties and this is greatly to his credit.

The weak point in Truschel's experiments lies in his method of bringing objects held in the hand to his subjects. Under these conditions the surface of the object is increased by the hand itself. Is it necessary to ask whether the object, without the hand, would have produced the same sensation? Certainly not. If the surface of the object is smaller than that of the hand, the main source of sensation is the hand; if the object is of the same size as the hand, the sensation received comes as much from the hand as from the object; finally, if the object is larger, the object will by the principal source ofsensation, in the same ration as exists between the size of the hand and the object. Truschel explains thesense of obstacles mainly though the perception of auditory sensations, and grants to tactile sens tions only a minor role.

2. The Pressure Theory of Kunz:

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Wladimir Dolanski.

Continuing the translation of Dr. Hayes.

trans. by Dr Stiles.

The Pressure Theory of Kunz.

Kunz affirms that a subject who approaches an obstacle feels a pressure on the face; that the sensations thus received are more easily perceived by those who have had epidemic diseases such as measles, small pox or scarlet fever; that these diseases produce a hyperaesthesia of the skin and thus increase its response to stimuli.

One of these assertions is very bold. Kunz affirms that he had verified the sense of obstacles in sighted (those having vision) who have had the diseases mentioned, but has never found it in any who had lost their vision as the result of an accident.

Kunz eliminates hearing from the phenomenon of sense of obstacles (which he again includes in the list of cutaneous sensations and which he calls "distance-sense" ("Fernsinn"), basing his judgment on the following premises;-

(a).- Certain deaf-blind have the sense of obstacles.

(b).- When the ears are stopped, the tympanum, the most sensitive of touch-organs, being then out of action, the obstacle-sense is not suspended, but merely diminished.

(c).-Absolute silence increases the range and favors the manifestations of the sense of obstacles; for although silence has no influence on the sensibility of the skin, all sounds distract the individual.

(d).-If the sense of obstacles were caused by sound-waves, the introduction of rubber tubes applied to the walls of the auditory canal ought to reduce it to a minimum. But the range of the sense of obstacles is not reduced after the blind person has become accustomed to wearing the tubes.

(e).- No difference was noted in the exciting-power of discs of different materials, (baize, wood, glass, etc.-, although sound-waves cannot be reflected from discs of baize as they are from wood or glass.

The following facts prove that the sense of obstacles is tactile in origin;-

1.- A low temperature reduces the acuteness of the sense of obstacles. Warming the skin doubles or triples its range. A warm bandage applied in cold weather also increases its range. Hearing, independent of temperature, does not enter into the case.

2.- When the subject is in motion or when obstacles are approached suddenly, the sense of obstacles is at once operative; when the approach is slow and uniform, perception takes place at much shorter distances.

3.- If the skin is rendered insensible by cocain, lysol or codein, the effective range of the sense of obstacles is reduced by 3o to 6o per cent.

Basing his opinion on what has been said, Kunz estimates that the sense of obstacles is a tactile sensation perceived by the skin of the forehead, the eyelids, the auricles and the tympani. He concludes that it is independent of hearing, for it is present when the ears are stopped.

During Kunz's experiments the objects were approached by hand, which produced rustling of the sleeves; so the same experiments were repeated with the objects at the end of rods, and according to Kunz, the results were identical.

The weak side of the author's arguments is not their arbitrary and categorical character, as Mme. Grzegorzewska says, but rather that they are contradictory and little in accordance with the facts.

Thus, to demonstrate that the blind feel obstacles through pressure on the face, he renders the skin anaesthetic with cocain and when subjects percieve the obstacle in spite of the anaesthesia, he concludes that the sense of obstacles must be the result of pressure. How powerful this mechanical pressure must be to be perceived, when patients thus anaesthetized submit without hesitation to surgical operations!

Kunz's other argument, (striking because of its lack of reality) is that the range of the sense of Obstacles is less in low temperatures than in high, the difference amounting to two or three times depeneding on the height of the temperature. Curiosity is excited to know on what this argument is based, for no blind person has as yet made this discovery. The personal experience of all of them has been that no matter whether they go out in winter or summer, whether they leave a well-warmed room and find a temperature of minus 20 degrees outside, their capacity for perceiving obstacles is not changed in the least.

The assertion that a warm bandage favors the sense of obstacles is cool weather is illogical; for if the face is bandaged, the blind subject will not feel the "pressure".
We shall not analyse these arguments of Kunz in full, for the reader is able to appreciate their value for himself.

III. The Thermic Theory of Krogius.

Krogius (K. Bürklein. Blindenpsychologie, p. 50) and Steinberg, Die Raumwharnehmungen der Blinden p. 41), emphasized the importance of thermic influences, in his analysis of the sense of obstacles. By way of experiment, he brought an empty, cylinder and then a cylinder filled with water at a temperature of 42 degress near the face of the subject, in silence. One side of this cylinder was painted white and the other black.
The cylinder with its black side toward the subject's face was perceived as being much nearer than the white side, when both white

and Black sides were at the same distance. This would go to prove the importance of thermic influences.

The blind perceived the cylinder having the temperature of the air at a distance of 213 mm. and when heated to 42 degrees C. at a distance of 337 mm. Sighted subjects percieved the object in the first of the preceeding cases at a distance of 21 mm.; in the latter at 135 mm. We see, therefore, that the sense of obstacles is approximately the same in both cases. The blind perceive better because they know better how to make use of their data.

Krogius continued his experiments by interposing waxed paper, bits of wool, felt, etc., between the subject and the warm cylinder. The lack of precision in the description of Krogius' experiments shows that they can have no scientific value. For example, he does not give the dimensions of his cylinder, which might have been either the size of a tumbler or of a steam-boiler.

The following objection, among others, comes to the mind of of those who analyze Krogius' theory. If the thermic difference existing between the face of a subject in motion and the obstacle might actually cause [illegible] obstacle-perception, the blind could never be able to feel the presence of a person at his side, since the temperature of all persons, with the exception of the sick, is essentially the same.

The Accoustic Theory as Interpreted by Villey.

Villey merits more attention, for, without allowing himself to be influenced by the work of his predecessors, he presents the theory of Truschl, but interprets it in a different manner. Being himself blind, he can easily interpret the truth of what has been written or advanced. In addition he is a man of science, accustomed to concentrate his thought and weigh his words. Having been in constant contact with the blind since infancy, he was in a condition to observe the perception-phenomena in his companions and consider their nature.

He determined that the blind are self-centradictory. The impression of touch-sensation on the face when they approach an obstacle is so distinct that the large majority of the blind reject any suspicion of illusion, while those who are more thoughtful and know better how to observe, admit that the phenomenon is complicated and that they cannot explain it.

Villey judges that acoustic phenomena are at the foundation of sense of obstacles; that there is no such thing as absolute silence and that the space surrounding us is filled with mumbers of sound-waves so faint that we can barely hear them. When we approach an obstacle it separates us from everything present beyond itself, and the silence thus produced leads to the conclusion that something is interposing between the world and ourselves. The proof of this is that the deaf-blind do not posses the sense of obstacles.

Out of ten normally developed blind, six or seven, perhaps,

were gifted with the sense of obstacles, while in the case of twelve blind-deaf, all intellegent and well-educated, studied by Villey from this point of view, not one, according to their own statements, possessed this gift; and what is more, three of them had had it when they could still hear. Many blind say that the sense of obstacles is diminished when their ears become less acute as the result of some transient illness, a cold for example. It follows then, that the sense of hearing is an indispensable condition for the sense of obstacles. As proof. Villey cites the following example. He placed a board 60 cm. long and 50 cm. wide at a distance of 70 cm. from his forehead. He felt nothing of its presence although he concentrated all his attention to that end. Then he made a noise by snapping his middle finger against his thumb and instantly produced a sense of touch over the entire surface of his forehead, although the acoustic surrounding alone had been modified.

Villey adds that he has no idea of how the phenomenon may be produced, leaving this to the work of the physiologists.

Attempts to explain the Obstacle sense according to various theories.

It might truthfully be remarked that although each of these theories posses attractive qualities under certain strictly defined conditions, not one of them has given a satisfactory solution of the problem. We will therefore pass in review other attempts that have been made to connect these theories with each other. Heller has made an attempt of this kind (T. Heller, Studien zur Blindenpsychologie. p. 116). He says that the blind child who has never changed his position in space gives us a picture of the development of the sense of obstacles. The phases of this development are as follows;-

At first the child moves with caution, advancing his hands and feet and does not change his direction until he has encountered an obstacle. After he has obtained a certain amoung of experience he stops before the obstacle, changes direction and goes around it. Eventually, since a blind person wishes to attract as little attention as possible from those about him, he keeps down the hands which he had carried outstretched at first. He thus loses his defense-surface and is forced to resort to the aid of the skin of his forehead and face, the most-exposed parts.

Heller distinguished three forms of encountering an obstacle.

1.- The obstacle is in motion.

2.- The subject is moving.

3.- the subject and the obstacle are advancing toward each other.

In all these cases there is collision with the column of air between the object and the individual.

In the first case (when the obstacle is moving), it compresses the column of air. The blind feel this as a pressure-sensation.

In the second case, when the subject is in motion, he exerts pressure on the air, which, reflected by the obstacle, acts on his face, but much less powerfully than in the first case, and occasions at the same time, a sensation of coolness. This sensation is the result of the fact that the skin gives up a part of its heat to the cooler layer of air which is in contact with it.

Heller does not analyze the third case.

Heller's experiments have demonstrated that the change in the sound of steps caused by the reflection of the sound-waves by the object which is approached, possess considerable importance for the sense of obstacles.

Assuming that this sense is made up of a complex of sensations, Heller separates them in his experiments by elimination successively touch, then hearing; that is to say, he has the blind guide themselves wholly by the ear and for this purpose covers the face and vice versa, by stopping their ears while leaving the face uncovered. The experiments took place in an empty room, where there was a table 1.65 m. high and 1 m. wide. At the beginning he placed a piece of flannel on the forehead of his subjects and had them go forward with hands crossed behind their backs. They were asked to stop at the first perception of the obstacle. The results were not positive. It is true that there were only two encounters with the obstacle and this because of the fatigue of the subject. But the blind often claimed to be in front of the table when there was no table in the room. When the table was placed parallel to the route of the blind, they often claimed that they were before it. When the flannel was removed, definition became more precise.

Heller assumes that his experiments prove that it is impossible for the blind to depend solely on auditory sensations. But the difficulties in obstacle-perception become much greater when auditory sensations are eliminated.

To state Heller's theory more specifically; the blind receive sensations in the following manner when they approach an obstacle;- The change in the noise of his steps causes the individual to prepare his attention for the tactile sensations that are soon to appear in the characteristic form of a sense of pressure in the region of the forehead. The blind person knows with certainty that he is going to encounter an obstacle in his path and can thus avoid it. In this way auditory sensations play the role of advance warning-signals, awake a condition of attention in the observation-centers, which in their turn, attract the attention of the individual.

The importance of thermic sensations in the genesis of the sense of obstacles does not seem to Heller to be properly explained.

In citing the opinions of different authors we have seen how many of them attribute an important significance to auditory sensations, but none of them has explaind them with such exactness as Heller, when he calls them alarm-signals. This explanation demonstrates remarkable acuity of observation in him.
The faculty for differentiating these signals is of special importance in the orientation of the blind in free space.

In 1923 Villey published in "La Revue Philosophique" a long article entitled "The Perception of Obstacles by the War-Blind" in which he describes an investigation he undertook among the old soldiers who had lost their vision during the war.

Villey says that he obtained replies from 63 blind, 42 of whom had established the existence of the sense of obstacles. Many of them describe in a most meticulous way how they percieve obstacles and it is possible to see that the idea of the capacity for sense of obstacles is confused in them with the faculty for orientation.
It should be emphasized that these people lost their vision after adult age, and with very rare exceptions, had no idea of the perceptive faculty of the blind. In spite of this they interpreted the question in the same way as all those we have presented in this work; that is, twenty-five per cent. judge they percieve obstacles with the aid of the ear; twenty-five per cent. that they experience a sense of touch and fifty per cent. that the sensation they recieve is a combination of both; certain of them timidly express the opinion that there is some thermic sensation.
Among these answered questionnaires returned to Villey by old soldiers, we find the reply of B.... who would see the action of magnetic waves in the sense of obstacles.
In closing. Villey writes;-
"I remain convinced that the auditory element holds a very important place in most cases and even in those cases having little or no consciousness of it, but that the tactile element is by no means negligible and that it is sometimes preponderant. In short, these two essential factors appear to play their respective roles, which vary in individual cases. There are, perhaps, tactiles and auditives, from the sense-of-obstacles point of view."
"But perhaps perceptions attain their maximum intensity only by means of a combination of these two classes of sensation."

George Lamarque, a pupil at the Superior Normal School, and interested in the psychology of abmormal sensoria, made a specical study of the sense of obstacles in the blind.
With this end in view he made lengthy researches among the pupils of the Normal Institute for the Young Blind at Paris, measuring the sensibility of the skin in the frontal, temporal and intermediary regions with the aid of a delicate apparatus which enabled him to measure forces as low as 1-10 of a dyne.
Lamarque came to the following conclusion after having experimented with seven subjects;-

1.- Obstacles are percieved at a distance either by the sense of pressure or by hearing; sometimes however, by means of a combination of the two.

2.- The first factor, pressure, never enters into acount when the subject is insensible to the action of a force less than 0.77 dyne.

3.- Trees are percieved at 0.6 to 0.7 M. with a threshold between 0.7 snd 0.96 dyne. The distance is increased to 1.20 when the threshold is lowered to 0.4 to 0.3 dyne.

4.- The temples will give information of objects only to the right or left. The temporal regions and the forehead give information as to objects located in front or to the side.

5.- When the ear alone is under consideration, there is perception to the front and laterally in certain cases, laterally alone in other cases.

Lamarque says that he has no explanation for this, not having studied the auditory sensitiveness in subjects who present this pecularity.

Later he writes;- "The error of all those who up to the present have studied the sense of obstacles is in having believed that it was the result of a single cause, the same cause in all cases. For this reason they have decided on an unknon cause in the presence of facts which seemed contradictory; or, having examined certain subjects who by chance belonged to one type, they thought that they always should draw the same conclusions from others; or, finally, their first confirmations having led them to suspect, for example, a muscular cause, they were not sufficiently on guard against the dangers of a preconcieved idea and accepted without suspicion the appearances which seemed to veryfy their hypothesis."

"However it must be granted that different causes are possible. The sense of obstacles is a substitution-sensitiveness; I mean that perception at a distance is made possible by the interpretation of facts, of impressions, which the seeing neglect, having no need for the imperfect information regarding the outside world furnished by these facts and impressions, and a priori both a muscular and an auditory origin of these gifts are equally possible."

"When one travels at a rapid gait in an open automobile, even though attention is but little on the watch, one can tell with ears stopped and eyes closed when one passes near a house. One feels something like a shock to the face. This is the same phenomenon produced when one goes toward a large tree or passes beside a wall; or when some strange body approaches; but it is much less tangible in these cases. The air thrown back by the subject or by the obstacle is compressed between them, offering greater resistance to displacement when the subject is walking; when he is motionless it presses on his face with more force.

The possible participation of the ear is less evident. Unquestionably it is every-day experience that the sonority of footsteps varies on the same ground, varies when one walks in an open space

or along a wall. One can unquestionably recogmize by the ear when an alley is passed or an arch entered. But if the sound is merely reinforced by such obstacles, it is not certain that a tree or a screen is capable of giving information even to the best-trained ear, for we are not sensitive to very slight variations of intensity."

Lamarque presents the conclusion which follows as the definite result of his study;-

"Until there is proof to the contrary, one has the right to consider as estabilished by experience that the blind always percieve obstacles because they feel light variations on the forehead, the temples or in intermediate regions, at their approach; light variations which are caused by the pressure of the air; or because their ear appreciates the change caused by air-pressure in the timbre of sounds or the nature of noises."

We shall omit the long columns of figures Lamarque obtained through the use of his little appartus for measuring the pressure on the skin of his subjects.

The method used by him to solve this problem which has wakened the livilest interest in the psychology of the blind, appears to us to be extremely artificial.

Grzegorzewska takes Heller's theory as her starting-point and as she says herself, she enlarges a good deal by trying to explain the phenomena by the laws of psychic structure, which form, in her opiniion, a union between the most diverse theories.

In this way she introduces the three factors of touch. thermal sense and audition into the phenomena of perception, but she attributes a constitutive significance to the tactile sense in the genesis of the sense of obstacles, while hearing and the thermic sense play only an auxiliary role. According to this author the tactile sense confines within itself this important role, which is fundamental from the theoretical point of view, for it possesses qualitles which are widespread and which are always present.

It would be just as possible to attribute a constitutive importance to the thermic sense, for it possess the same qualities and can be theoretically regarded as fundamental; and on the other hand, observations prove equally that it is fundamental for it is constantly present.

In addition to the conditions of sense of obstacle cited by Heller ; namely, 1.- The individual approaches the obstacle. 2.- The obstacle approaches the individual. 3.- the individual and the obstacle approach each other, the author mentions with Truschel, the last case, when, 4th, the individual and the obstacle are motionless in relation to each other.

Dr. Grzegorzewska justly remarks that many authors confound the sense of obstacles with the orientation-faculty. But to avoid repetitions we will speak of the opinions of Mme. Grzegorzewska in another place.

II.

Personal Observations.

I lost my sight suddenly in early infancy,as the result of an accident. The new conditions of life in which I found myself were strange to me: an innate vivacity and my infantile temperament aroused an internal need for free movement, as it had earlier,when I was everywhere,and I paid no attention to the remonstrances of those about me who advised me to keep quiet and "not bump myself." I took my first steps without paying any attention to anything. Everywhere I encountered different objects and ran into them,sometimes with painful results. I could not possibly tell how many bumps I collected during that time. But all this did not happen without profit,for the instinct of preservation began to be aroused in my subconsciousness, my attention became keener,I commenced scrupulously to observe everything going on about me and naturally a day came when I noticed one detail,namely,a strict correlation between the contact with the obstacle and the instant preceeding the shock. It was a specific and delicate physical sensation,a light grazing hard to explain,on the forehead and temples and more especially on the parts of the cheeks about the ears.

This sensation was so short,passing and peculiar in its nature that I did not rightly know if it was an illusion or something real. I began to observe,impelled by curiosity; to observe myself. Holding my breath, on the point of my toes, I softly approached an obstacle,but the sensation was capricious and did not always come when I wanted it. I noticed little by little that these sensations never appeared when I knew where the obstacle was and inversely,they always came when i found myself unexpectedly confronting an obstacle.

No one among my friends could explain this phenomenon to me, and defined it as something special and peculiar to me personally, as we have already seen. This explanation satisfied me entirely and I was content to get from it the greatest amount of practical genefit. Some years later when it was possible for me to meet other blind, I noted that they knew how to do the same thing,that they received the same sensations and that these sensations were not extraordinary and were not peculiar to me. I knew how to perceive the presence of an obstacle located at the height of my head. The kind of material - Kunz speaks of this in his experiments - had no influence on the quality of the perception; the thickness, whether smooth or polished and the mass of the object were of no importance. The metal grilles of the garden although they constituted an obstacle,were not percieved until I ran into them.

The difference between my condition as a person with vision and my present condition was as follows;-

Visual perception permitted me to embrace at a glance all the data regarding an object; its form,its color,its size,the distance separating it from other objects and its location with reference to them; while the sense of obstacles permits only the determination of the presence of an object,and I could get the precise data as to its nature only indirectly through the workings of my imagination,whose information did not always agree with reality.

Preliminary Remarks.

When some years later I was in Paris for the purpose of becoming more intimately acquainted with psychology and pedagogy, I met with literature treating of the sense of obstacles. The subject interested me the more because there was a fundamental difference between the publications of authors and my personal observations and I went to the laboratory of the school of experimental psycho-physiology at the Sorbonne and there presented my ideas and my plans for studying the phenomenon to Professor Pieron. I began the work with the aid of M. Francois, assistant to the chair of experimental psycho-physiology, though the greater part of it was carried out in my own laboratory, set up in the Institute for the Blind at Lask, near Warsaw. At this Institute (which belongs to the Society for the Assistance of the Blind), pupils of school age who were being systematically instructed, adult blind, - tutors, employes either in the Braille printing house or workshops of the institution, were available.

The total number of blind was 120 but it was not possible to use all of them. The small children did not know how to fix their attention or define their feelings and certain of the adults were too occupied or too often indisposed to come regularly for the experiments.

It is my duty first of all to thank the Administrative Council of the Society for the appreciation and cordial assistance it has been good enough to give my undertaking, as well as all those who have devoted a little of their time to me and who have thus contributed toward the birth of this work. I was able to experiment with 42 persons of both sexes and of different ages, certain of whom were blind (1), since birth, (2) following accidents, (3) following illness

I worked out a plan before I began my experiments in which I established the conditions that fitted my aims. First of all I had to repeat the experiments of Heller, Kunz and Truschel, taking all precautions possible to the end that the factors of secondary moment, such as suggestion to the subjects, lack of precision in the experiments, etc., might not influence the objective results of the analysis.

It was then necessary to give an interpretation based on a scientific foundation of the results obtained, and to make use to this end not alone of psychological knowledge but also of the facts of physics and aerodynamics.

All who, up to the present, have tried to explain the sense of obstacles have limited themselves to dogmatic assertions, the result of more or less correct observations, without learning whether these assertions were in accordance with the claims of scientists who were more competent in this connection.

Absolute Silence.

The opinion of almost all authors that a loud noise or complete silence influence the sense of obstacles negatively is entirely false. Although as a matter of fact the object may not be perceived in a loud noise, it is easily perceived in absolute silence. Orientation however is imcomparably more difficult in silence in large open spaces, such as public squares or the open fields when there is silence.

The following tabulation shows the relation of noise and silence to the sense of obstacles and to orientation.

In the midst of loud noise.
In workshops where machines are in motion, in the streets, in busy market-places.
Perception of obstacles; very difficult, almost impossible.
Orientation; very difficult; almost impossible.

When the noise comes from a distance.
The murmur of a fountain, noise of a carriage travelling on a near-by street; inside the house; the roaring of a fire in the chimney; the ticking of a clock. (Villey).
Perception of obstacles, Easy
Orientation Easy.

In absolute silence.
When one walks on grass, on sand, or on moss or on the snow; in the house on carpets, etc.
Perception of obstacles. Easy.
Orientation. Very difficult, almost impossible.

Truschel in his observations on the sense of obstacles mentions that there is no such thing as absolute silence and that it is because there is no such thing that the blind are able to percieve objects, even if the object and the subject remain motionless with relation to each other. According to him the sense of obstacles is caused by relatively silent sound-waves arising from different sources and reflected by the obstacle.

Villey and Dr. Grzegorzewska repeat these remarks of Truschel without explaining this incomprehensible phenomenon which, however, is simple, when it is considered in the light of the physical laws of the earth's atmosphere.

The rays of the sun successively illuminate all parts of both sides of the equator, as a result of the continual movememt of the globe about its axis. The heated air becomes rarified and rises. When it has reached a certain height it takes on two opposed directions toward the two poles. Its original place is taken by a layer of cold air which comes from the poles toward the equator. Continual modifications of the atmospheric pressure caused by the steady tendency to equalize temperature-differences, set up vertical and horizontal currents in the air which are manifest not only in the form of stronger or lighter winds but also as air-waves inperceptible to our senses.

This continual movement of the molecules of the air produces

friction and puts them in vibration, the result being that silence in the exact sense of the word does not exist at all, although these little waves are not percieved in the tumult of daily life.

To avoid misunderstandings,we accept the term "absolute silence or complete silence" as it is employed in current usage and shall thus use in in the rest of our work.

Description of the Experiments.

I decided to make my experiments in absolute silence because any auditory excitation caused by the movement of the obstacle gave information as to orientation. I wanted to analyze only the sense of obstacles,excluding anything that might suggest the approach of an obstacle to the subject,and decided that in this way only could I be able to obtain objective and certain results.

With this end in view I had an apparatus constructed which approached and withdrew the obstacles. It was composed of a rectangualr support 1.20 m. long by 40 cm. wide,with geared wheels connected in pairs by means of an axle attached above to its short sides. Geared rails rested on these wheels. Wheels and rails, when set in motion to right and left by a crank,put some long metal bars in motion also. The discs serving as obstacles,were placed at one end of these bars. The other ends of these bars were fixed at a right angle to the geared mechanism by a screw. The bars were thus moveable throught their whole length by the motion of the geared mechanism.

The obstacles were placed at a distance of 2.50 m.

At one end of the stand was a desk with a millimeter measure to indicate and control the distance of the excitation-threshold, and a chronometer to calculate the speed of the obstacle.

At the other end of the apparatus was a chair resting on wheels on the rails,with a rest for the head. This arrangement allowed the withdrawal of the chair from between the bars that sustained the discs,after the experiment,and its replacement for another experiment at exactly the same place; that is to say, the position of the chair with reference to the apparatus remained unchanged.

The apparatus worked without the slightest noise and the obstacles were brought forward a millimeter at a time, with a steadiness of motion so perfect that there could be no question of any air-currents. The speed as indicated by the chronometer, was from 1 to 2 mm. per second and the flame of a candle placed on the metal bars was not in the least deflected from the vertical at that speed.

The obstacles had the form of discs of different diameters

(between 20 and 500 mm.). They were made of various materials, sheet-iron, wood, cardboard, glass, cloth.

Our experiments were divided into four series.

1.- Discs approached the uncovered face.

2.- Discs approached the face with the ears veiled.

3.- Discs approached the face covered with a mask.

4.- Discs approached the face with the ears stopped with cotton.

In addition the discs were approached in two different ways;-

1.- In the first the disc (N) was approached horizontally at the height of the face, or, (laterally), at the height of the ears, until the moment it was perceived by the subject at a distance (X).

2.- In the second, the same disc (N) at the distance (X) but above the level of the head, was lowered vertically down to the face in such a way that the movement of the disc cut the air and in this way excluded all possibility of pressure from the column of air between the disc and the face of the subject.

The discs were approached toward each ear separately or together, toward the forehead, the lips, the cheeks, the entire face and over the head.

Figure 1 represent the arrangement of our apparatus and Figure 2 will give an idea of what the experiments were like (See the original test for illustrations).

First Series.

The disc approached the uncovered face.

Discs were approached both vertically and horizontally in this first series. All sizes of the discs were used from 20 to 500 mm. in diameter and record was kept of the various materials of which the discs were composed.

Certain subjects, possessing a finer ear and better able to coneentrate their attention, perceived discs down to 40 mm. in diameter near their ears, but other subjects could not perceive anything with the discs of less than 80 mm. in diameter. Discs of less diameter than those mentioned were not percieved at all, for their surface was too small, even when they were brought very near the auditory canal.

No reaction at all was produced with discs less than 100 mm. in diameter when they approached from the front.

In Case 4, to be exact, the subject might have been able to percieve the disc from his breath upon it as it approached him from the front. In order to avoid this the disc was lifted above the mouth during expiration and lowered again at inspiration. Working thus, the disc was approached until it contacted. This may be explained as follows;-

The discs, approached from in front so that their central point corresponded to a vertical line dividing the face into two symmetrical halves, form veils too small to be perceived by either ear when they entered the auditory field, although they were perceived when approached laterally.

When the individual hears with one ear only, the disc approached from the front is perceived by the hearing ear at the same proportional distance and with the same size of disc as if the other ear could hear.

With very faint noises or very small obstacles, each ear percieves independently of the other only the noises present in its own auditory field.

When sounds or noises, such as conversation, produce acoustic disturbances within a certain radius, they are perceived at the same time by both the ears, if they are within the area of the disturbances.

Discs brought toward the head from above downward were not perceived in a single instance is spite of all possible attention on the part of the subject.

Second Series.

Discs approached the face with the ears muffled.

In order to throw light upon the role of the surface of the face independent of hearing, in the phenomenon of sense of obstacles, we resorted to experiments conducted with the ears of the subject muffled.

The ear-muffs used were of very thick paper, adjusted so that the walls adhered to the face at a right angle to it. The auditory field was thus divided into two parts; an anterior and a latero-posterior part. The wall of the ear-muff met the face beside the auditory canal, and formed a barrier for sound-waves coming from the front. Sounds of different character and human voices of different intensities which originated to one side or behind the head, reached the ears unchanged, but those coming from the front were slightly weaker and as if muffled. Light sounds or murmurs did not reach the ears at all.

When the discs were approached laterally to the muffled ears, the distance needed to determine the stimulus-threshold remained the same as that obtained without ear-muffs. However, when the

discs were approached from the front under the same conditions, even the largest discs (diameter 500 mm.),were not perceived, and to the great astonishment of the subjects,an encounter with the obstacle was inevitable.

If the mechanical pressure of the air had been great enough to be felt by the face,the subjects would unquestionably have perceived with ease the sensation under discussion.

Third Series.

Discs approached the face covered with a mask.

I considered it indispensable to make a series of experiments with the face of the subject covered by a mask, in order to compare then with the experiments in which the ears of the subject had been muffled. While it had been a question of studying the face with hearing excluded in the preceeding work, it now became necessary to exclude the face and study the functioning of the ear exclusively.

The masks were of pasteboard and had the form of a face. They covered the entire face back to the auditory canal.

All of the blind at first objected to putting on the mask, cla—iming that all possibility of perception would thus be abolished. This objection,almost generally expressed, proves that the idea of obstacle-perception through the face is deeply rooted in the mind of the majority of the blind.

As to the results,they were astonishing; for the subject, having the impression that the conditions of the experiment had become more difficult,and wishing to furnish a maximum of data, concentrated his attention with greater force than usual.
Thus in certain cases the distance-measurements of the stimulus-threshold for perception of discs of the same dimensions were greater than under normal conditions; that is to say,without the mask. In other cases distances obtained with the mask were the same as without it,when the discs were approached from the front or from the side. In no case was the distance with the mask less than under normal conditions.

Fourth Series.

Discs approached the face with the ears stopped with cotton.

The last series of experiments was made on subjects whose ears were stopped with cotton. The discs were not perceived at all,regardless whether they approached from the front,toward the face,or from the side, toward the ears.

It is curious to remark that certain subjects reported the presence of an obstacle when it was not in their neighborhood and when the obstacle was not being moved at all.

These experimental results recall the experiments of Kulpe,

Perky and Schaub, (Witwicki, Psychologie, I p. 218), who determined that perceptions correspond for the most part to derived representations.

Details concerning the Experiments.

The experiments performed have demonstrated that the material of which the obstacle is made does not influence in the slightest degree the quality of the perception. After the presence of an obstacle has been determined nothing else is known.

Well-fitted dark glasses through which light could not possibly filter were worn during the experiments by subjects who possessed some remains of vision.

At first each disc was moved up 50 times and the mean of the results was taken, but when the same distances were repeated almost identically for each disc, the approaches were reduced to 10 times. This made no difference in the averages.

Each séance lasted about 45 minutes. It was not possible to prolong them beyond this time for the incessant concentration of attention fatigued the subjects and blunted their sensibility.

During each seance the obstacles were brought up from 10 to 20 times, depending on the ability to concentrate the attention, which varied much with the individual.

Permanent control of the surrounding temperature was maintained during the experiments and atmospheric pressure was noted at the same time. It was found that neither factor had any influence on the sense of obstacles.

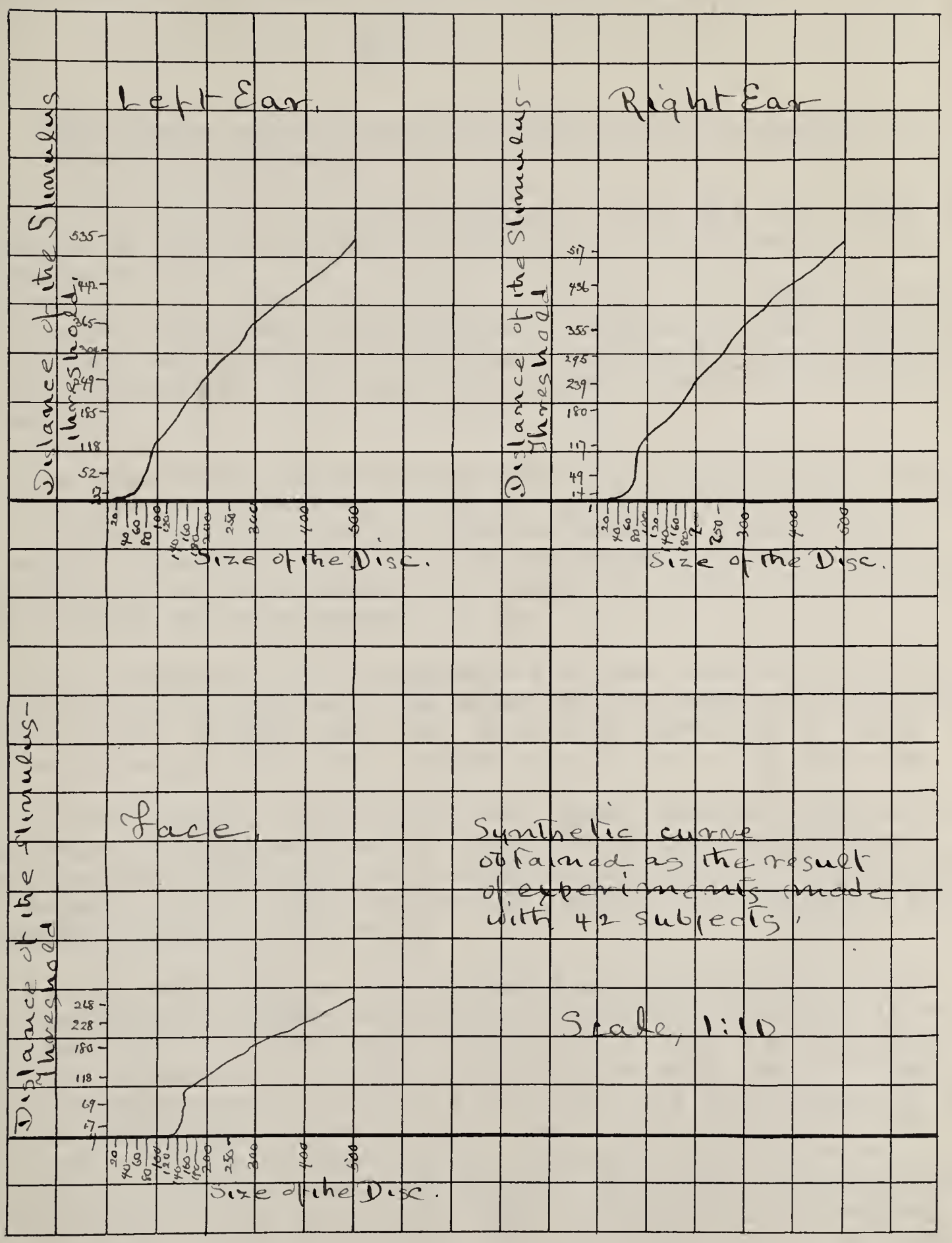
In the contrary. however, psychic conditions, fatigue, exhaustion, distraction, etc., have a very strong influence on this faculty. When the subject is fatigued or distraught, the results of the experiments were much less positive, for although the conditions of the experiment remained unchanged, the distance of the stimulus-threshold was diminished.

These variations are accurately represented in the diagram, (P. 169) we have constructed and which illustrates the differences of acuity noted during the experiments between the right and left ears. The graphic curves represent synthetic diagrams of experiments made with 42 subjects.

Causes of the blindness of the subjects submitted to Experiments in the Laski Laboratory.

Blind from birth.	6.
From scarlatina.	1.
From Smallpox	6.
Through accident	10.

The diagrams were arranged according to the causes of the blindness of the subjects and [illegible] in alphabetical order. But to avoid increasing the dimensions of this work, we give only


Left Ear.
Distance of the Stimulus
Threshold.
535
442
365
304
249
185
118
52
17
20
40
60
80
100
120
140
160
180
200
250
300
400
500
Size of the Disc.
Right Ear
Distance of the Stimulus
Threshold
517
436
355
295
239
180
117
49
17
20
40
60
80
100
120
140
160
180
200
250
300
400
500
Size of the Disc.
Face.
Distance of the Stimulus
Threshold
268
228
180
118
69
17
20
40
60
80
100
120
140
160
180
200
250
300
400
500
Size of the Disc.
Synthetic curve obtained as the result of experiments made with 42 subjects.
Scale, 1:10

the final graphic curves,which give a synthesys of the 42 diagrams.

Scale is 1:10 . The distance of the stimulation-threshold and the diameter of the discs is given in millimeters.

III.

Discussion of the results obtained as the result of our experiments.

We have grouped in the preceeding table all the subjects submitted to experiment,with reference to the cause of their blindness.

The table shows that the cause of the loss of vision does not exercise any influence on the sense of obstacles. The blind in the table were either blind from birth or as the result of various diseases of the eyes,of accidents and of variola or scarlatina.

The experiments of Kunz are supposed to show that those who have had such diseases as measles,small-pox,scarlet fever, etc., - diseases which in his opinion produce a skin-hyperaesthesia - are most sensitive to the sense of obstacles. He denies all perceptive faculty to those who lost their vision as the result of an accident.

Our experiments have demonstrated that the cause of the blindness has no influence whatever on the sense of obstacles, for the table, P. 168 shows that each and every one of them has the sense of obstacles without any differences whatever.

We have further determined that under certain conditions there exists a constant ratio between the distance of the sensation-threshold and the area of the obstacle. This proportion depends on the place where the obstacle is located with reference to the blind person.

As we mentioned in presenting the experiments of the first series,an obstacle of size N,percieved laterally at a distance X if it is in front of the subject,with a distance of about X;2 separating it from the face,the left side of the obstacle being perceived by the left ear,its right side by the right ear,then the center of the disc corresponding to the middle of the face is lost and not perceived by the ears. These data cannot be established with mathematical precision, for the attention of the individual is continually changing and he cannot, as our diagrams show,function like an automaton. The height of the curves becomes less and less,for the distance of the sensation-threshold must reach a stable limit beyond which no obstacle,no matter how large,can be perceived.

When the disc appears and is appreciated by the ear,

it has the same effect as an occluding object in the visual field.
Vision can be directed in all directions, can embrace an entire area and see everything within a given sector, except what may be behind an occluding object. This is also true as regards the disc. The ear, straining at attention, lies in wait to seize instantly the slightest murmur. If there are any perceptible murmurs under normal conditions it will hear even the very slightest, but when the murmur is behind the disc, the ear no longer percieves it.

The results obtained in our experiments demonstrate clearly that hearing is the sole basis for the sense of obstacles and that the sensation produced by mechanical pressure of the air has nothing to do with it.
The proof of this is found primarily in the results of the experiments of the IInd series - with ear-muffs - and of the IVth -the ears stopped with cotton - which demonstrate that discs of 500 mm. diameter were not perceived before they struck the face, and the experiments of the IIId Series - with mask- in which the subjects percieved the obstacle approaching from the front as well as he did without the mask.

Evidence to prove that hearing is fundamental in the origin of the sense of obstacles.

All who have had occasion to be intimately acquainted with the blind, know that passing indispositions, such as colds, or diseases of the ears, diminish their capacity for the sense of obstacles. This transient or permanent blunting of hearing is proportional to the sense of obstacles in the subject and when hearing is completely destroyed the faculty also disappears quickly.

Kunz claims to have established by his researches that the deaf-blind - among others the celebrated Hellen Keller of Bston and Malossi of Naples - had the sense of obstacles. Villey wrote however, in "Le Monde des Aveugles" after completing his inquiry into the matter, that he had asked eleven well-instructed and intellegent blind-deaf, if they possessed the sense of obstacles . They all -and among them, Helen Keller and Malossi - replied that they did not possess this faculty. Three among them told him that they had lost it when they had lost their hearing.

Foot-note.- Villey. Le Monde des Aveugles P. 90. "Another proof is furnished by the fact that deaf-blind have not in general the sense of obstacles. I know well enough that Kunz declares he has proved the sense in numerous subjects.- Helen Keller of Boston and Eugenio Malossi of Naples,- who are sometimes reckoned as among his subjects, wrote me personally saying that they did not have the sense of obstacles - but I have already told why his proofs are not decisive. Moreover,

Dr. Marage assures me that certain deaf who hear neither musical sounds nor the spoken voice perceive certain extremely feeble sounds very well and,for this reason, it is his opinion that if one were to encounter a deaf-blind with a sound skin,who has the sense of obstacles,one need not necsssarily conclude that the ears of such a subject have nothing to do with the sense of obstacles. Be this as it may,however, while six or seven normal blind in ten make use of the frontal and facial impressions of which we are speaking,of eleven intellegent and cultured deaf-blind I have been able to question,not one has any knowledge of these impressions. Three of these had the sense of obstacles while blind and before they became deaf,and all three say that deafness abolished the sense.

Later Villey in his article published in the Revue Philosophique of 1923,cites the testimony of a war-blind.
"I went about freely in Bordeaux. I took a half-hour walk every day to the Chateau of Lescure where I was learning Knitting. I distinguished a house at 7 to 8 meters, a wall at 4 to 5 meters depending on its height,and a tree at 2 to 3 meteres according to its size. To-day this sense has been almost entirely absent for nearly three months as a result of the condition of my ears. Its absence deprives me of a very large part of the work,I could do without running into obstacles and bruising myself."

Villey adds "He has practiced persistently since his recent misfortune and has tried to train himself,but has obtained no results."

Mme. Grzegorzewske explains as follows the loss of the sense of obstacles following the loss of hearing;-
"The individual who has built up his sense of obstacles on the basis of tactile-auditory sensations and makes use of the structure ,is not able to change this complex; for the loss of one part of the tactile-auditory complex interferes with the genesis of the other part and he loses his sense of obstacles."

Foot-note. 1. (M. Grzeorzewska, Psychologja Niewidomych, Warzawa, 1930, p. 91.) "Certain facts mentioned by Villey to which we give a different interpretation, may be explained thus;-
The sense of obstacles disappears when the ears are hermetically sealed and certain blind ceased to receive these impressions when they became blind. We explain these facts in the following way;- The individual who has constructed his sense of obstacles in the basis of tactile-auditory sensations and is making use of this complex,cannot immediately change its structure; and that is why his obstacle-sense is destroyed. But this does not contradict the fundamental role of touch,audition being merely its warning monitor."
P. 92 "In Villey's case of a blind person who did not perceive obstacles until the moment auditory sensations became available, we have to do with a tactile-auditory structure in which the lack of one of the elements of the complex restrains the action of the phenomenon."

It is too bad for Science that Mme. Grzegorzewska did not cite a sngle case in which the blind still possessed the sense of obstacles after the complete loss of hearing.

Is it possible that an association so powerful has been established between the sensations of the two distinct senses that the two elements can exist only the one with the other, and that with the destruction of one the other is reduced to zero? We know that Pavlov nourished animals for a long time accompanying the feeding with sensory stimuli. Auditory stimuli of different kinds were used. The pitch, intensity and timbre of the sound was determined for each animal. Circles, ellipses, etc., of different colors were projected on a screen and gases possessing characteristic odors were made use of, When the animals had been thus trained for some time and when the two phenomena, that is to say, the sensory stimulus and the accompanying food, had become associated, a very special psychic structure became established in the animals. The appearance of the accompanying stimulus sufficed to cause the gastric glands to produce gastric juice which flowed out through a tube introduced into the stomach through the flank of the animal.

If it were possible to associate the two stimuli, - the signal and the food - in such fashion that one could not appear without the other, the animals trained by Pavlov would starve to death in the midst of food if they were deprived of the signal announcing the arrival of their ration, and set at liberty.

But Nature has shown herself more clement toward the majority or living beings and all, whether they be Pavlov's animals or old soldiers accustomed to the trumpet to call them to the mess-hall, know well enough how to taste a good morsel without any signals.

Let us take another example. Imagine an individual who has lost his vision as the result of illness or an accident. He must adopt himself to new conditions of life and learn to make the most of the gifts the other senses furnish him. Mme. Grzegorzewsk says in her "Psychology of the Blind" that the blind give attention to all the qualities of the senses. The divisibility of their attention is hardly to be imagined. When they move in space, their senses, fearing danger, become so acute that it might be said of them that "they hear the grass grow".

And now suppoing that the same individual, who has all the peculiar faculties of the blind, loses his hearing. Must he not in such case adapt himself anew to his changed conditions? And as is the case with hearing, must not touch be more sensitive and skilful to differentiate tactile and pressure stimuli? Just as formerly this individual surpassed the seeing in the art of seizing upon different noises and rustlings ignored by the sighted because they were of no use to them, so now the same individual should surpass the blind because of his ability to feel touch and pressure stimuli, and as a result, perceieve obstacles by pressure alone.

But since this is not the case, there can be no question of any mechanical force acting in the form of pressure on the face of the individual who is approaching an obstcale.

If two sensorial impressions, X and Z, for example, an auditory and a tactile sensation, appear as the result of two independent stimuli, M and N (a sound and a pressure), each one of these sensations X and Z should be able to produce the one without the other (i.e., either sound or pressure) as soon as the stimulus provoking it apears, without regard to the power of association in the psychic structure thus produced,

Villey cites Dr. Marage (Villey. "Le Monde Des Aveugles." P. 90.). Marage insists there are deaf people who without hearing sounds of speech can hear murmurs. Further, according to the author, if a deaf-blind is encountered who has the sense of obstacles, it must not be concluded that his ear has contributed to the sense.

Dr. Bonnier (Dr. P. Bonnier L'Oreille, t. III, Psychologie p. 47) in an excellent treatise on the ear, cites a whole series of cases of abnormal audition caused by disease, among which we can find phenomena which clear up the possibility of a sense of obstacles in certain deaf-blind. For example, let us consider one of my personal observations. Mrs. Anna von B... living in Warsaw, suffers not alone from hemerolopia with evident failure of the optic nerve, but also has a very troublesome enfeeblement of the organs of hearing. It is necessary to speak very loud to her, for she hears neither normal conversation nor an electric bell nor the bell of an alarm clock. But she perfectly perceives the faint noise of a finger tapping on a door. Even when busy talking in company with a number of people, she hears when one knocks at a door separated from her by two rooms, although no other person can hear it.

The celebrated deaf-blind Marie Heurtin de Larnay (near Poictiers) replied to Villey's questions by saying that she percieved obstacles at a very short distance, and then only in the open air. It is to be regretted that some one, who was competent to determine whether she actually possesses the sense of obstacles and to what degree, might not have made experiments with her. Her evidence cannot be a sufficient proof, for no one knows what she heard when she perceived an obstacle in the open air.

Villey cites the case of M. Geugan, (deaf-blind), who perceived obstacles by the sense of smell. He also had the impression of grazing, of a light passing touch on his forehead when he approached an object. He loses the sense of obstacles when he has a cold or stops his nose with clips, and then has no tactile impression on his forehead. We have here another example of the fact that it is not mechanical pressure which plays a role in the sense of obstacles. An exceptionally acute sense of smell has replaced hearing in this case. Villey observes with correctness that although the case of M. Guegan is the only one he knows of, it does not follow that it is the only one in existence.

In 1902 Javal mentioned a detail cited later by Villey; that the esthesiometric researches of Weber showed that the tactile sense is best developed at the tip of the tongue, on the lips and at the tips of the fingers, and is much less well developed on the

forehead and cheeks. Why do not the blind who walk with their arms advanced to avoid striking their heads, perceive by means of the tips of their fingers? Would they not, perhaps unconsciously, employ the tip of the tongue as they went forward to guard against shocks of contact, assuming that the column of air exerts a pressure sufficiently powerful to be felt as a tactile sensation?

Foot note. Villey. Le Monde des Aveugles. P.88 and following. "Sensitiveness is great on the balls of the fingers and on the lips. If the experiments of Krogius are to be believed, as they commonly are, sensitiveness in many subjects is greater on the balls of the fingers than on the forehead. If the sensations with which we are dealing are truly and exclusively pressure-sensations, is it not strange that no blind has ever been encountered who could percieve an obstacle before his hand or near his lips? Let a blind person with the most delicate touch extend his hand toward a wall. His most sensitive fingers will not perceive the wall, I will not say at 6 to 8 meters, but even at a millimeter. Sensation comes only with immediate contact. Some other factor enters into the sense of obstacles and this is none other than audition."

Heller in 1904 and Künz in 1907 let this just observation of Javal pass without comment and wished to establish a theory of pressure without taking the manifest truth of the phenomenon into account ; a truth which can admit of but one interpretation.

The argument of Javal would suffice absolutely to sap the foundations of all work based on the acceptance of the pressure and touch theories in the genesis of the sense of obstacles - but his argument has not been sufficiently appreciated.

The description given by Heller (Heller. Studien zur Blindenpsychologie, P.116), of a blind man approaching an obstacle is alos to be found in the work of Dr. Grzegorzewska. According to her this phenomenen is as follows;-

"When a blind person approaches an object the column of air which separates him from it is broken up, thrown toward the impenetrable obstacle, is reflected there and returns in the reverse direction toward the blind, whose sensitive face-surfaces are impressed by it. In addition, the movement of the air produces a sense of coolness, for the skin gives up a part of its heat to the layer of air next it, the temperature of which is lower. This sensation of coolness plus the tactile sensation on the face form a complex of differentiated [redacted] sensations; that is to say, a constellation of stimuli."

Our experiments of the third series, with the mask, have demonstrated, in opposition to the preceeding opinion, that the subjects with a mask on the face perceived obstacles just as they would without the mask. There were even some cases in which

the sensation-threshold distances were greater than without the mask,as has been explained above.

We have obtained identical results when the sense of obstacles was tested in the same subjects at their own initiative in the house and out of doors,with the face covered with a mask and without the embarrasment of laboratory surroundings.

The mask has no influence on the sense of obstacles other than a feeling of embarassment caused at first by the sticking of the mask to the face.

The experiments of the second series were confirmed outside the laboratory in the same way when two subjects approaching a tree,only that one perceived it who was turned in the direction of the obstacle to one side,with his ear directed toward the tree.

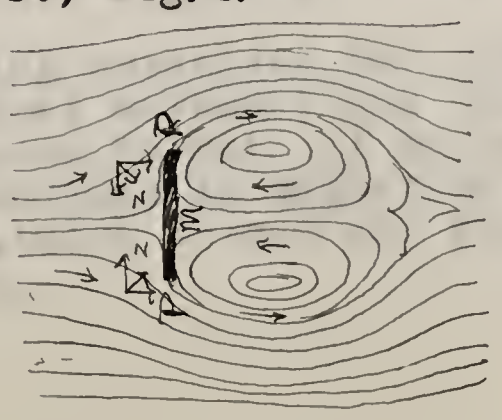
When the ears of the blind were plugged with cotton the sense of obstacles was taken from them. All their attention would then be concentrated on tactile sensations in the soles of their feet which could furnish nothing but information as to orientation.

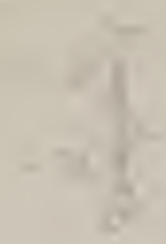
These results prove sufficiently that the assertions of authors who attribute the sense of obstacles to tactile and thermic sensations are baseless and devoid of truth.

We shall never know the grounds from which they reason. But in order that the question may be definitely solved we have resorted to the latest facts of aerodynamics ,which are decisive in our controversy.

Although a mass of water at a temperature of 10 deg. C. is 800 times as dense as air,the phenomena taking place in water give us a picture of analogous phenomena in the atmosphere. The same phenomena (pressure on the anterior part and suction on the posterior part of the disc),are produced whether a disc is moved in a calm atmosphere with its surface at right angles to the line of motion,or whether its surface is struck at right angles by a current of air.

If now we immerse a disc with its surface at right angles to a current of water,we notice that,irrespective of the swiftness of the current, the water does not rebound from the disc, but the current divides into two symmetrical parts at the center of the disc and gives place to another mass of water. These two masses of water separate in opposite directions and go around the disc to right and left, Fig. 4.





Having passed the borders of the disc, they form first two symmetrical whirlpools at its posterior part, then resume their normal course. The phenomenon may be observed if lycopodium powder, which floats, is thrown on the running water in front of the disc.

We have not mentioned whirlpool formation on the back of the disc as it has no relation to our work.

Thus the opinion which announces that a column of air moved in certain direction, is reflected by an obstacle which it encounters and returns back by the way it came, does not possess any foundation of a scientific character, as we see it.

So all production-methods for the sense of obstacles based on pressure exerted on the face by a column of air reflected by an obstacle, as brought forward by Kunz and Heller, when worked out to the minutest details, is nothing but the pure work of their imaginations.

Explanation of the sensations which appear on the face of the Blind.

If the impressions felt on the cheeks are not produced by pressure-waves of air in motion, nor by thermal stimuli, what is their source and how are they produced?

In order to make a sensible reply to this question, we consider it necessary first of all, to present a trait of the human psyche which remains with a man during his entire life, and which becomes the source of a complexity of sensations in the blind.

In addition to the qualities which are strictly a part of the development of man, we are able to notice an unrestrainable desire for movement, made manifest in the will to work or play.

Groos asserts that men do not amuse themselves in infancy because they are infants, but because infancy and youth were created to afford amusement and that the psychic and physical structures thus attain their full development.

According to Sourian we do not work because we have ends to attain, but we propose ends to ourselves so that we may work.

Among other theories Claparede (Dr. E. Claparede, Psychologie de l'Enfant et Pedagogie Experimentale, Geneva, 1924, p. 435), suggests that the play of children is a preparation for serious life, just as scale-exercises are indispensable to the person wishing to become a good pianist.

Without declaring ourselves for either of these theories, we agree in saying that movement and play arise from an instinctive impulse to be doing, to act. It is, therefore, not at all astonishing to find contentment in satiating our internal needs and to feel depressed when, being normal and well, we are reduced to inertia and immobility.

Durkheim correctly says in his work "La Divison du Travail Social" that happiness is within reach of every living being themonent he is able to satisfy his desire.

It goes without saying that the blind possess the same disposition for movement,games and action,although this inclination cannot be developed as fully in them as in the sighted. Constant collisions with objects about them oblige them to move with prudence and attention. They can give free course to their temperament only in well-known neighborhoods,and then not always with impunity.

Change from one place to another is the forbidden but desired fruit to the blind and when they taste it,they often do penance.

Tis natural that foreknowledge of an evil that is certain to strike us should awake the sentiment of fear in us. And this fear is all the greater if we have a more fertile and livilier imagination.

A complicated process is established in the soul of the blind from the moment he becomes conscious of fear. Two feelings are in combat; one,the desire for movement,for play and action, called forth by vital needs; the other,the fear of consequences, as uncertain and unknown as the mathematical X. These two strata of feelings are the faithful companions of the blind.

But these negative consequences which awake fear are not inevitable if the needed precautions are taken. For example fear, at bottom,is conductive to a feeling of hope.
"I wonder if this time I can avoid making a carom when I go out."
"And even if this time my expedition is a failure,it need not be said that success will not crown it the second or third time."

Moreover,the audacious are prepared for any eventuality and consider each of their attempts as the best yet.

The quotation from Villey in "Le Monde des Aveugles",relating to the case of M. Geugan demonstrates the power of the force which obliges us to move and do;-

"M. Geugan went about,entirely alone,in his native village (Brest),although he had been deprived of hearing as well as sight. It was only bicycle and automobile traffic rolling along on the asphalted roads without setting up the earth-vibrations that aided M. Gaugan in orientation,that put an end to his walks alone.

Constant fear of disagreeable surprises of which nothing is known as to source,time of occurrence,extent or gravity,creates a disposition to suspect misfortune. Hence that wakeful,alert, attention paid to the slightest details to which the sighted

attach no importamce whatever.

When the blind are walking, the slightest noise, the least murmur, an echo brought by the wind, act as checks to diminish the force of a collision. At the same time a light grazing, a surface-touch, is felt on the face, the temples and the forehead, independent of the actual presence of the obstacle and without regard as to whether the sound is actually reflected by the obstacle or is merely an illusion.

A slight slope in the terrain, a board yielding under the feet, is sufficient to send the same chilly current through the body and limbs.

The source of these sensations which appear distinctly as tactile sensations is the certainty that an accident is threatening.

The following example will furnish proof that the cause of tactile sensations of the body are to be sought in a feeling of conviction.

"I was living in the country and while there, I had to travel a kilometer every day on a road which was quite deserted at the time I went out. A house stood near the road at a turning. A troop of dogs sprang out on me from this house and I owed my safety only to my coolness and my cane. The dogs became more and more agressive from day to day and I drove them off with increasing difficulty. Finally one day I noticed that I felt a disagreeable tingling in my back at the first bark. This feeling was extremely painful and, wishing to put an end to it, I armed myself with a bamboo pole, two meters long with which I forced the beasts to keep further away."

In reporting his experiments, Heller asserts (T. Heller, Studien zur Blindenpsychologie. Leipzig, 1904, pp.117, 118, 121), and W. Steinberg (Die Raumwahrnehmung der Blinden, p. 38), that when the subjects had a bandage on the forehead, they ceased to perceive tactile impressions on the face. From this he concludes that a bandage is a sort of armor which does not allow mechanical pressure to penetrate to the face.

This interpretation of Hellers is false and it is necessary to look elsewhere for the cause of the sensations. The blind man wearing a bandage on his forehead knows that he is protected against the consequences of a contact. This certainty does away with all fear and from the moment fear ceases to exist, the sensations in question no longer appear.

Heller explains the process of sense of obstacles thus;- when a blind person percieves an acoustic modification and following it, recieves a light touch or brushing on his face, he knows with cetainty that he is before an obstacle. In reality the process occurs in this way;- after having received a sound-warning, I know with certainty that I have an obstacle before me, and it is because of this knowledge that I feel a light tactile sensation on my face. The certainty of an imminent danger provokes a

reflex action which manifests itself as a tactile sensation on the surface of the skin."

If a blind man existed who had never run into anything as he moved about within the limited bounds of his little world, he would have no more conception of these sensations on the cheeks than would a person who had never felt fear and had no idea of the signification of goose-flesh.

The important role of derived representations in the genesis of the obstacle-sense is demonstrated by the example of Villey, mentioned on P. 3. The noise produced by rubbing one finger against another gives warning of the presence of an obstacle unpercieved up to that time, and provkes a centrifugal reaction in the form of tactile sensations over the entire surface of the forehead. A sound of no significance at all was sufficient not only to bring images derived from objects in the road before Villey's "eyes of consciousness", but also to represent to him the concrets picture of the disagreeable consequences which awaited him. Bruises on the forehead and cheeks, sometimes a hard blow on the knee or perhaps a bleeding knee; sometimes low obstacles, are sufficient causes not only for conscious but for reflex action toward self-preservation.

The memories of an accident form a group of derived representations and these together with perceptions, form the character of the sensation.

It follows from what we have said that the source of this sensation of a cold brushing touch on the face is <u>located</u> in <u>the fear</u> which slumbers in our subconsciousness and which gives rise to a <u>reaction</u> of the <u>instinct of preservation</u> in the form of a cold draft which passes through the nerves as a prevision of collision.

It remains only for us to explain in a few words how these tactile sensations are produced.

Obliquely-set hair-follicles are present on the surface of the body together with the sudoriparous and fat-glands. Contractile muscle-fibers with communicating nerves are attached to the bases of these hair follicles. As a result of certain nerve-impulses set up by fear, these muscular fibers contract and the hairs are erected perpendicularly to the surface of the skin. This action <u>produces the sensation</u> of tingling, of a cold <u>touch</u> on the cheeks and in moments of terror, the feeling that the hair is standing on the head. This chill of terror is regarded as a remaining vestige of the temperament of our hairy ancestors, who bristled and thus assumed a formidable aspect at the sight of an enemy. A cat bristles in this way when atacked by a dog, and the dog or horse does the same when they scent the wolf.

The role of the instinct of preservation.

In his book " Die Welt als Wille und Vorstellungen", Schopenhauer expresses perfectly the signification of the will and sums it up in these words;- "In all cases, having to do with either the individual or the species, a tendency to preserve life is to be seen.

The desire to exist, the will to be, rules everyone. Consciously or unconsciously the will works in us, without interruption; though body and mind become fatigued and require repose, the will alone is untiring. The germinating seed turns its stem upward, its root downward, regardless of its position in the earth.

The will to live is the most powerful factor sustaining the existence of all living beings. We submit ourselves to it consciously or unconsicously, and we are compelled to avoid everything that might injure us in one form or another. This instinct is a psychic structure made up of six factors;

The first is composed of our personal impressions, produced by external stimuli.

The second is the consciouness that classifies the quality of the received sensations.

The third is the factor of sentiment, which produces anguish, fear horror, varying according as the sensitiveness of the individual is greater or less.

The fourth is the reaction which leaves the nerve-centers and follows a sensory path toward the menaced organs, or whih traverses the entire body and contracts the muscular fibers attached to the hair follicles thus provoking a tingling or a feeling of touch. When the sense of obstacles of the blind is under consideration, the same physiological phenomenon appears on the forehead and the temples or cheeks, these parts being uncovered and most menaced by collision.

The fifth is a reaction that takes a centrifugal path from the centers, along the motor nerves parallel to the preceeding, and which provokes a reflex in the menaced organ or in the entire body. In the case of very great fright, all the reflexes may be momentarily suspended.

The sixth is an intellectual factor which makes a decision in accordance with the immediate damger, according to the circumstances, the degree of intellegence and the individual speed of orientation of the individual, before action is taken to avoid the immediate peril. This is brought about automatically and with such speed that it seems to be one uniform entity, in which the first and last factors appear most clearly.

Following the repetition of certain functions and of the concentration of attention on certain constant phenomena a sensitiveness is produced which is adequate to allow the carrying out of these functions in a conscious and final manner, without special reasoning. It is in this way that the soldier reacts to commands, or the chauffeur reacts with his hand on the wheel, when an unsuspected person appears in front of his machine going at full speed. Those who take a pen to write also react in the same way. They write without any deliberation concerning the movements that make up the action of writing.

We also react in the proper way to a stimulus, when necessary, without setting all our intellectual mechanixm in motion, though this latter action is indispensable when we do anything for the first time.

This pychic structure is developed in all men, but more amply so in the blind, for they are constantly menaced with collisions. It sets up in the blind the phsycolgical sequence just described which manifests itself on the face.

Illusions in the sense of obstacles.

All authors have insisted on the fact that illusions of proximity of obstacles are frequent and are produced most often when a wind, even a very light breeze, is blowing. The light wave-sounds brought by air-currents and subjected to numerous modifications assume a characteristic timbre resembling the noise reflected by an obstacle and are percieved by the ear as if they were noises from an obstacle. The blind person then stops suddenly, fearing collision with the object he thinks is before him and receives that specific brushing on the cheeks at the same time.

The source of this sensation on the face is not at all the external mechanical pressure exerted on the skin, but a reaction coming from our nerve-centers. The recollection or sight of a lemon provokes a similar reaction which contracts the salivary glands in the mouth but this contraction is not caused by any external mechanical force.

I shall allow myself to quote here another example taken from my own experience. As I have already mentioned, I lost my sight suddenly in infancy as the result of an accident. But a little vision was left me; very little, it is true, but when I became reconciled to the situation I was satisfied with this feeble remainder. I distinguished perfectly the light of a candle brought near my eyes. I clearly saw the light of a lamp placed beside me but I perceived best of all the large round sparkling disc of the sun, whose rays were scattered about in the sky like sparks. Its light troubled me so much that I winked my eyes and they filled with tears.

When the sky was covered, a feeble gilded ray issuing from the clouds, and coming to rest on my face, was sufficient to cause the world and my soul to become more gay because I could see it. I said to myself then that it was good to see even to this infinitesimal degree. In passing. I will add that I have an excellent visual memory, which allows me to recreate in my imagination not only objects I had previously seen, with their colors, but even a picture, a landscape, provided I had some person beside me to describe exactly what he saw.

It is therefore not in the least astonishing that everything took on the tints and animation of life to the eyes of my imagination when I encountered light. Only one thing astonished me. Why could I not perceive the shade of the outlines of persons, of stoves, of trees? I explained this to myself by the fact that the remains of my sight were so infinitesimal that they reacted to light alone.

This conviction had never left me for twenty years, when chance one day revealed a reality of which I had not the slightest conception. One day, after one of my readers had left me, I pushed back the table occupying the middle of the room and according to my habit, began to pace back and forth, meditating on the

work which had just been read to me. While thus sunk in thought I suddenly touched the lighted lamp hanging from the ceiling. This impressed me. Why had I not seen the light as I approached the lamp? And I instantly asked myself if the sight remaining to me was not an illusion. I at once took a piece of black cloth and wrapped the bulb in it so that the light could not possibly pass through the wrapping. Then as I slowly approached the lamp I felt progessively and simultaneously two sensation as I came near; a sensation of radiant heat from the bulb,and a sense of light, although it was certain on this occasion that no light was visible. This simple experiment showed that in infancy,notions of light and heat had become so firmly associated that they could not now be separated. I know to-day that I no longer see light,and yet when I feel the heat of a lamp on my face or the heat of the rays of the sun,I receive the sensation of light and at the same time my eyes wink and fill with tears as if there were light. In the same way. when specific noises are associated with obstacles,a stimulation excited by these noises is sufficient to produce a sensation of brushing or a light nervous current on the face,the temples,etc.,

It is curious to note the origin of the sensation of light-stimulation on the cheeks when the ear is straining in complete silence to determine whether an obstacle is near. This is found in the extreme sensitiveness of the sensory fibers which arise in the nerve-plexuses of the face and ear. One of the branches of the auroculo-temporal nerve supplying the external auditory canal sends a branch to the tympanic membrane. Another branch of this same auriculo-temporal group unites in the tissues of the salivary gland with branches of the facial and furnishes these branches with sensory fibers which terminate in the skin about the jaw. (lower).

Thus the strain of attention in the ear easily provokes stimulation of these sensory fibers and of the sensory fibers of the facial and auricular nerves in the portions of the cheeks about the ears; for these nerves communicate with each other. These sensations are extremely delicate and might be likened to those produced by a scarcely perceptible breath of air. Their qualities,so difficult to define,identified them long ago with the sensations received at the approach of an obstacle.

Conclusion.

As a result of all that has been said up to the present, an affirmative reply may be made to the question as to whether the blind possess a sense of obstacles. But this affirmative reply by no means permits the supposition that a special organ exists,whose function it is to perceive obstacles as the function of the ear is to perceive auditory sensations. It is to designate a structural mechanism the basis of which is the instinct of self-preservation and the exciting principle is the hearing.

The sensations of grazing,brushing or light touch appearing after the warning-signal,are the result of a physiological reflex process. In such exceptional cases as that of M. Geugan,(the blind-deaf), hearing has been replaced by smell.

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